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BioArray Solutions

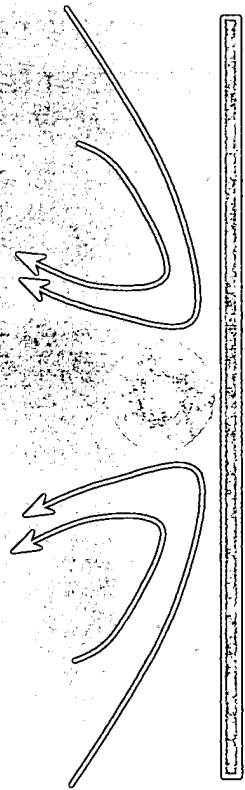
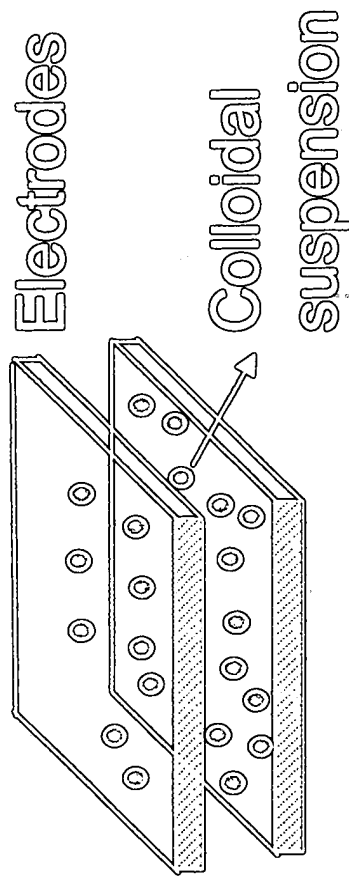
# 2-D Array Assembly Using Light and Interfacial Patterning

Michael Seul, Sukanta Banerjee, Kairali Podual, Alice Li, Chiu Chau

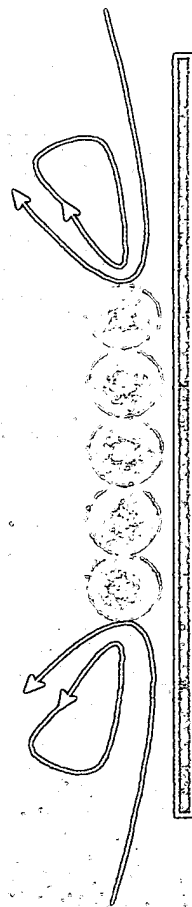
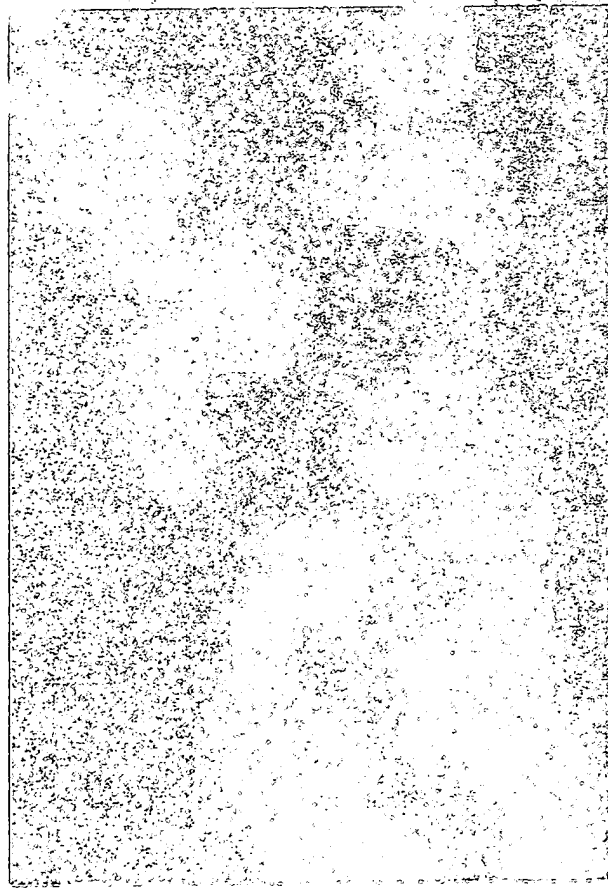
BioArray Solutions  
120 Centennial Avenue  
Piscataway, NJ 08854  
[www.BioArrays.com](http://www.BioArrays.com)

03.05.01

# Field Induced Crystallization



Axially symmetric toroidal flow field



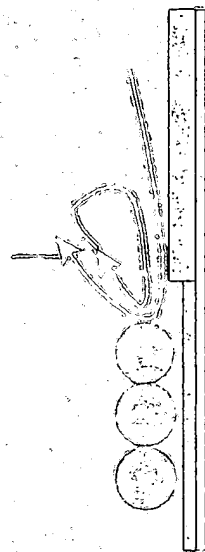
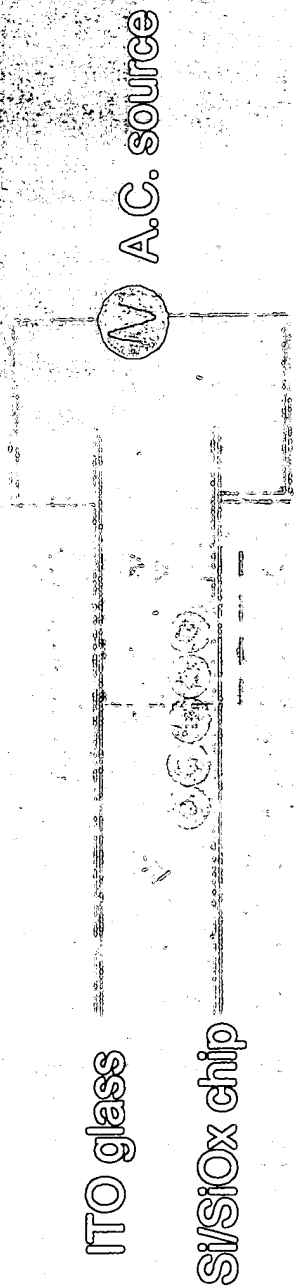
2-D crystallization

Richetti, F., Prost, J., and Barois, P. J.  
Phys. Lett. 45, L1137-L1143(1984)

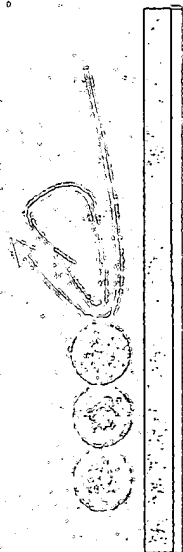
Yeh, S., Seul, M., and Shraiman, B. I.  
Nature, 386, 57-59 (1997)

# LEAPS

Light - Controlled Electrokinetic Assembly of Particles Near Surfaces



Interfacial patterning

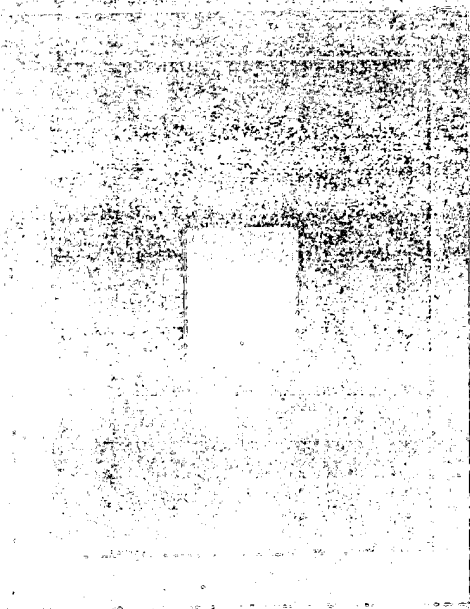
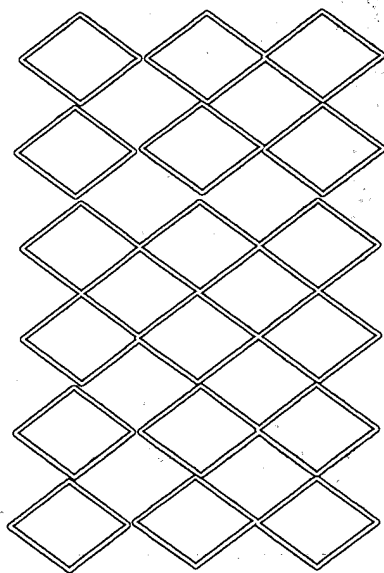


Light patterning

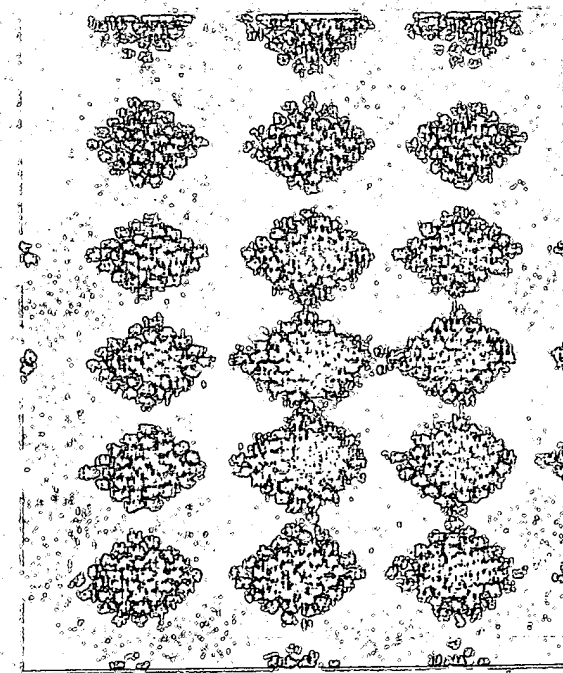
Seul, M. WO 97/40385

# Light Patterning

Mask



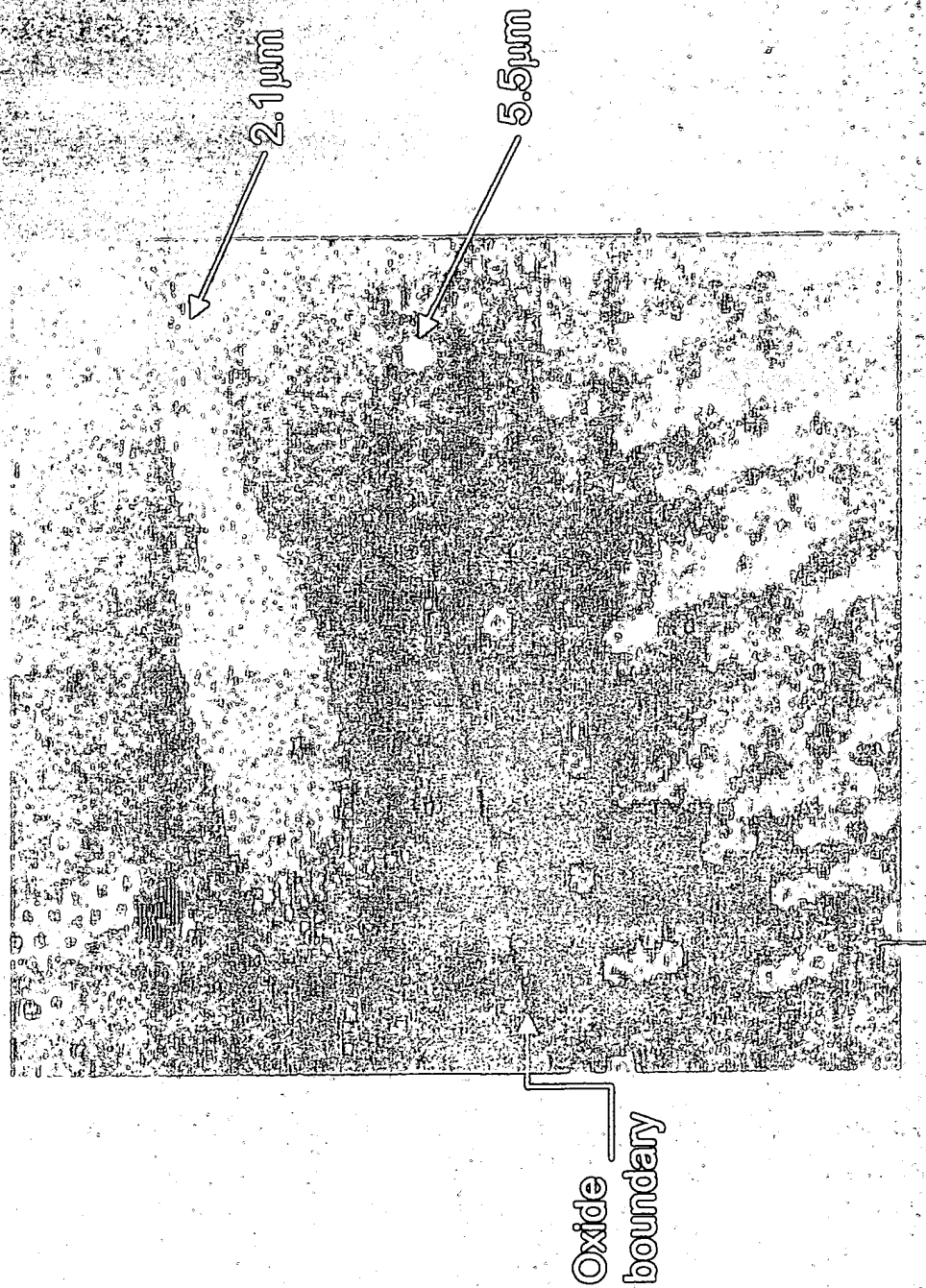
Assembly



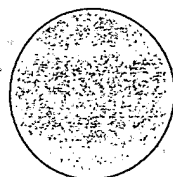
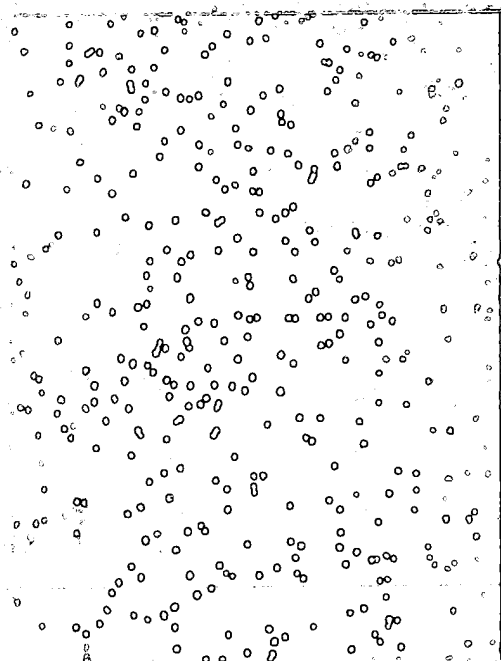
# Modeling of LEAPS

- Electrode-Insulator-Semiconductor (EIS) Interface
- Electric Field Distribution
- AC Electro Osmotic Flow (EOF)
- Bead Polarization
- Equation of Motion

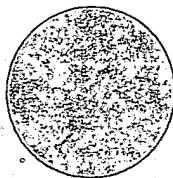
# Sorting by Size



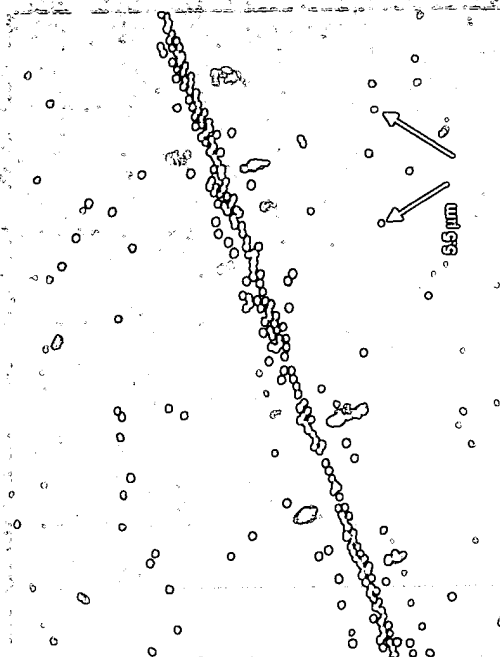
# Sorting by Polarizability



Carboxylated 5.5 μm particle

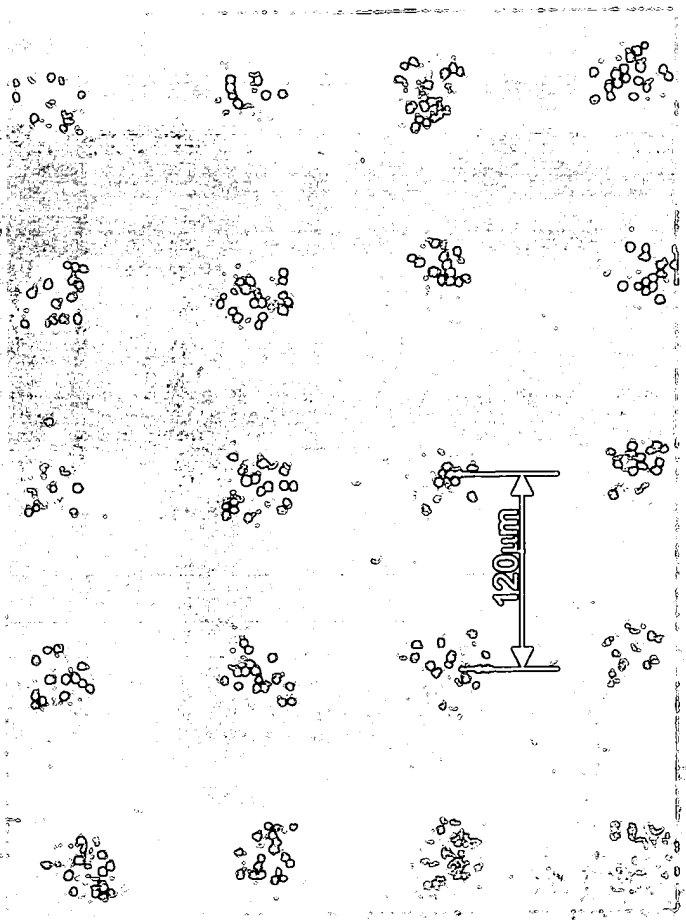
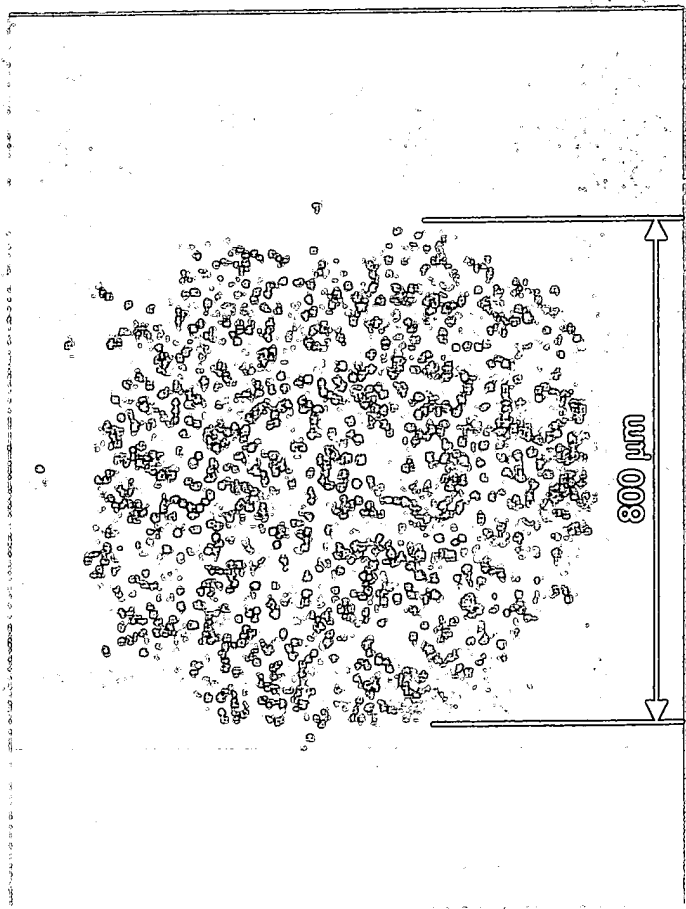


Protein conjugated 5.5 μm particle



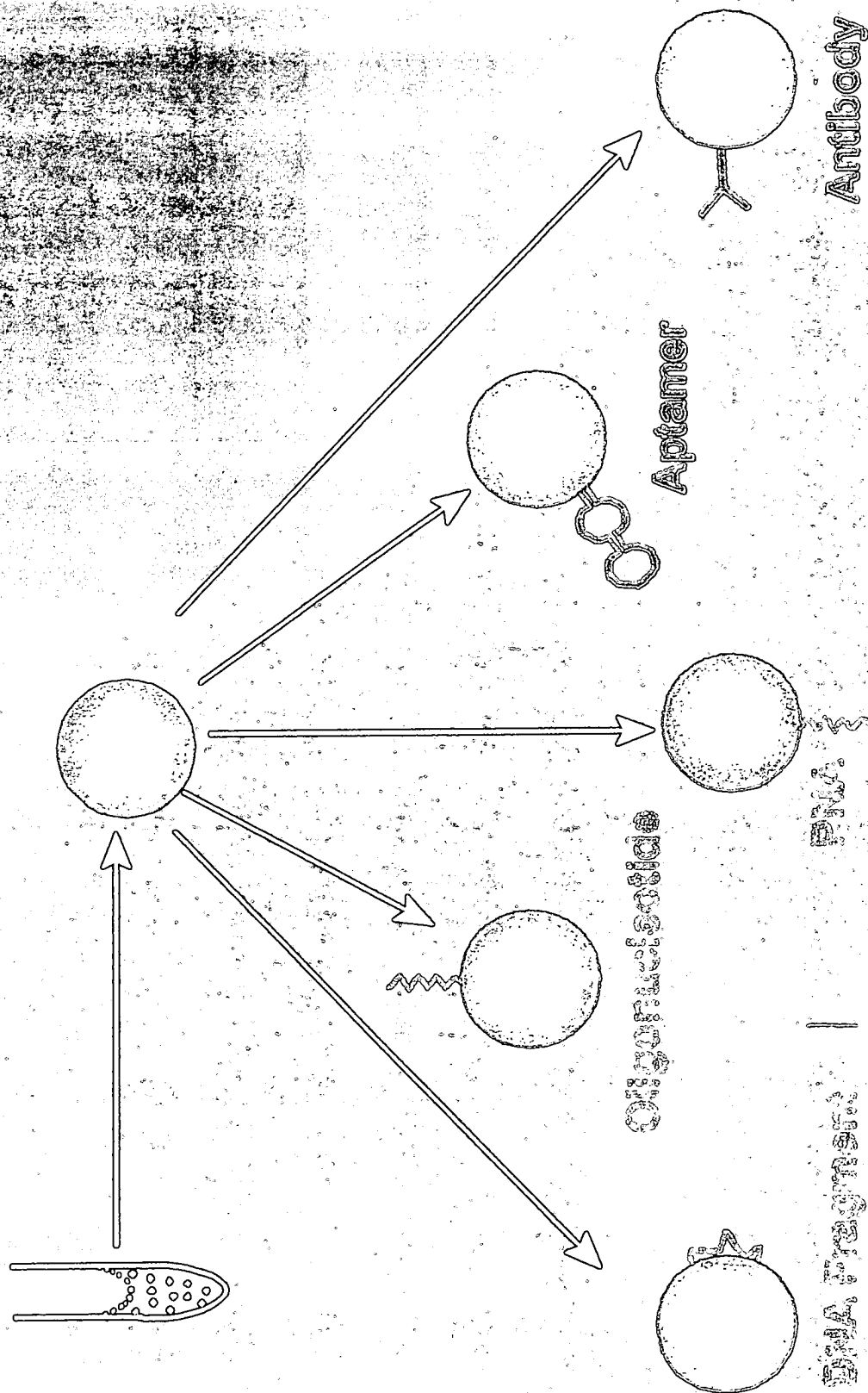


# Random Encoded Array Assembly



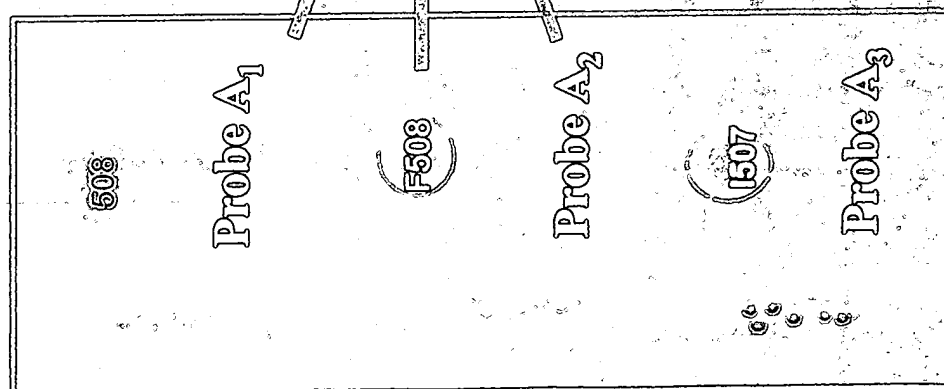
# Functionalization

## Multifunctionality

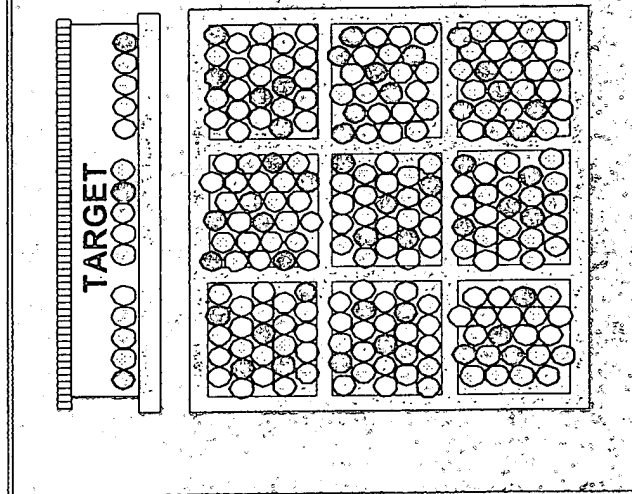


READ

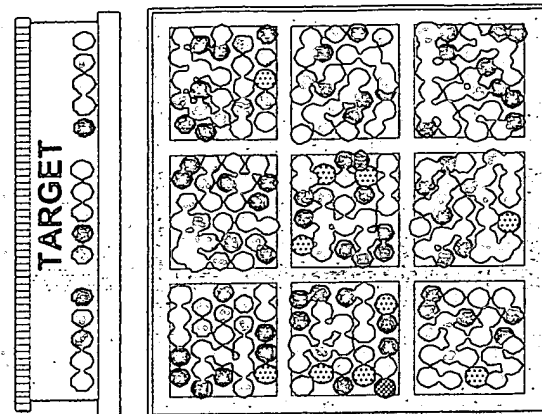
# Random Encoded Array Detection



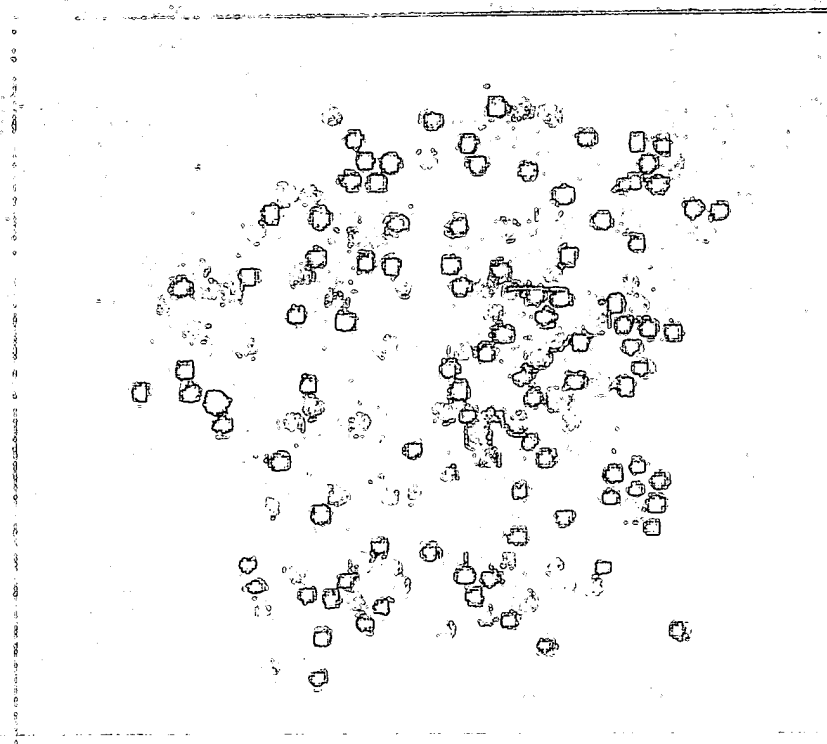
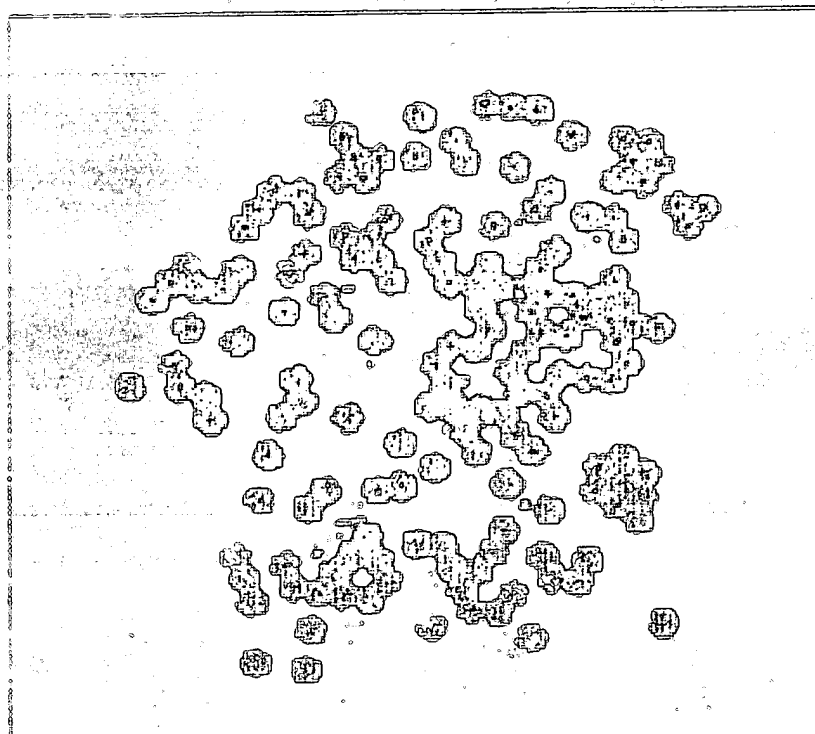
Assay Image



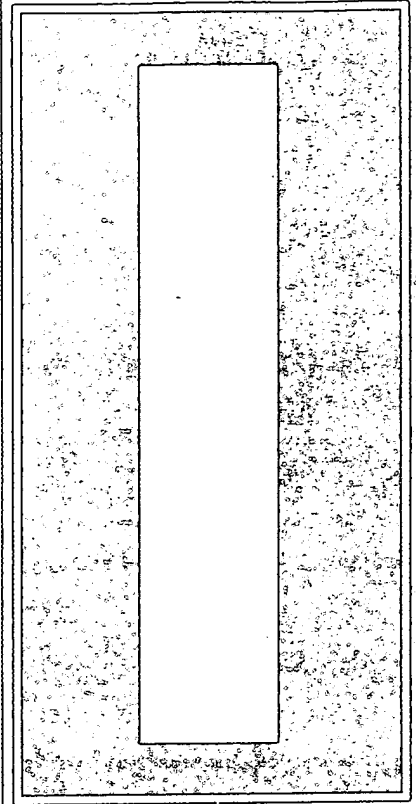
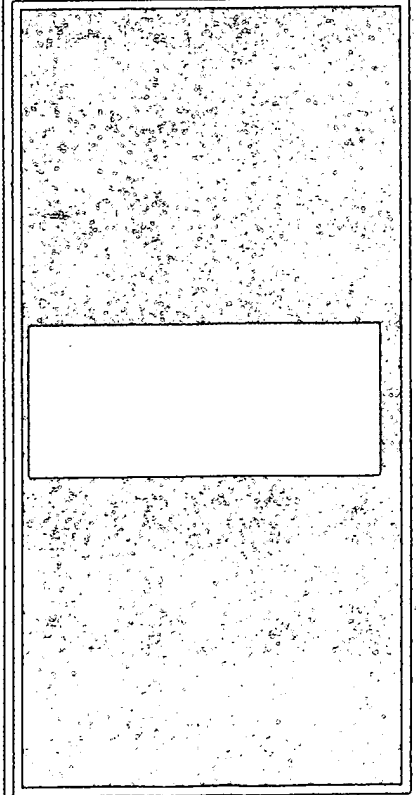
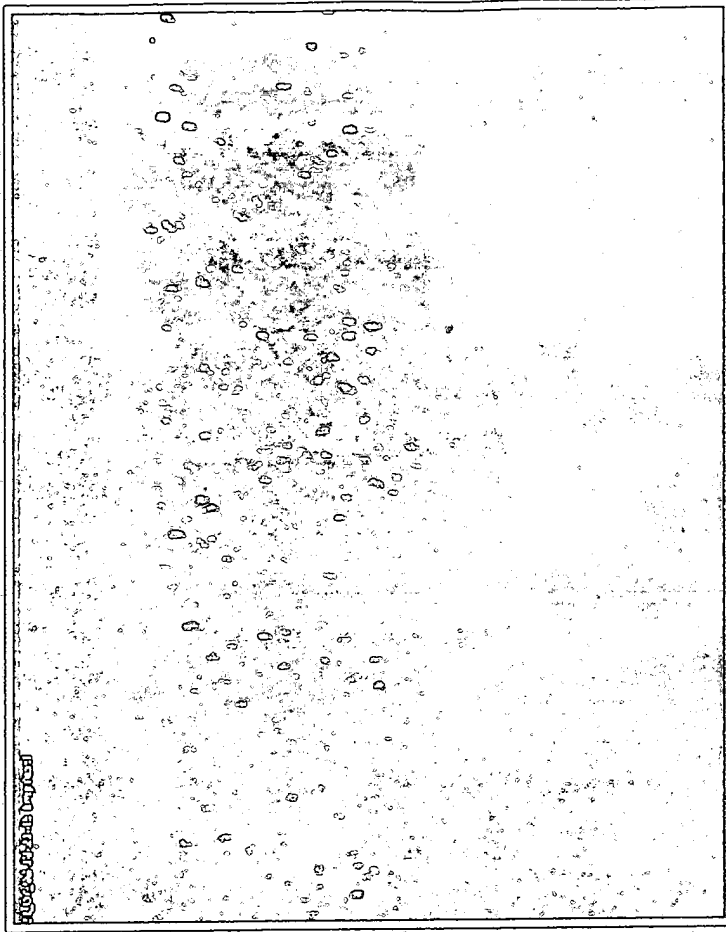
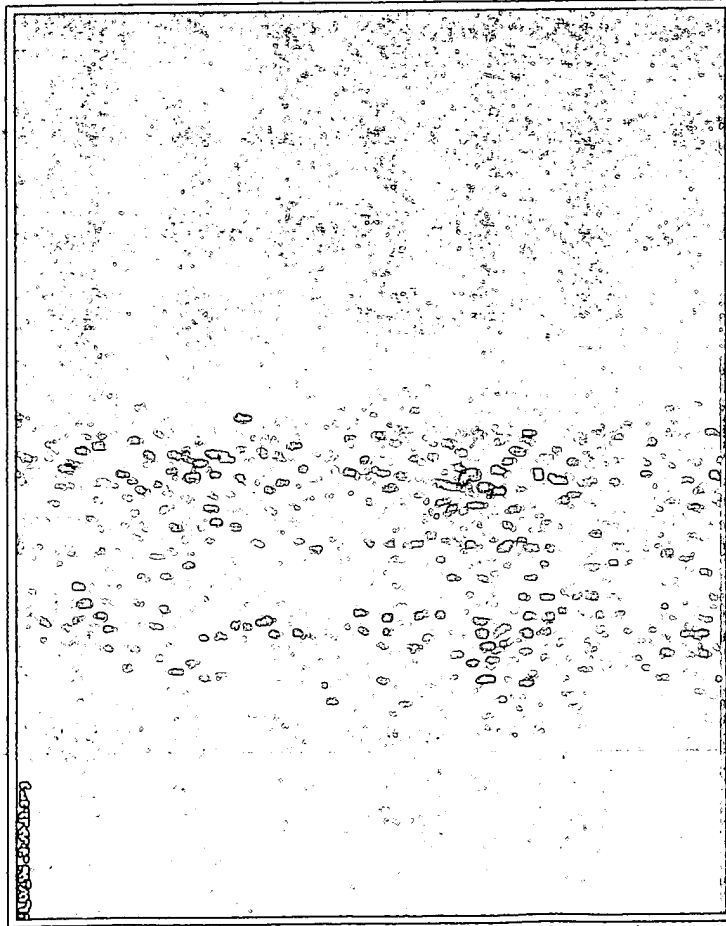
Decoding Image



# BioArrays



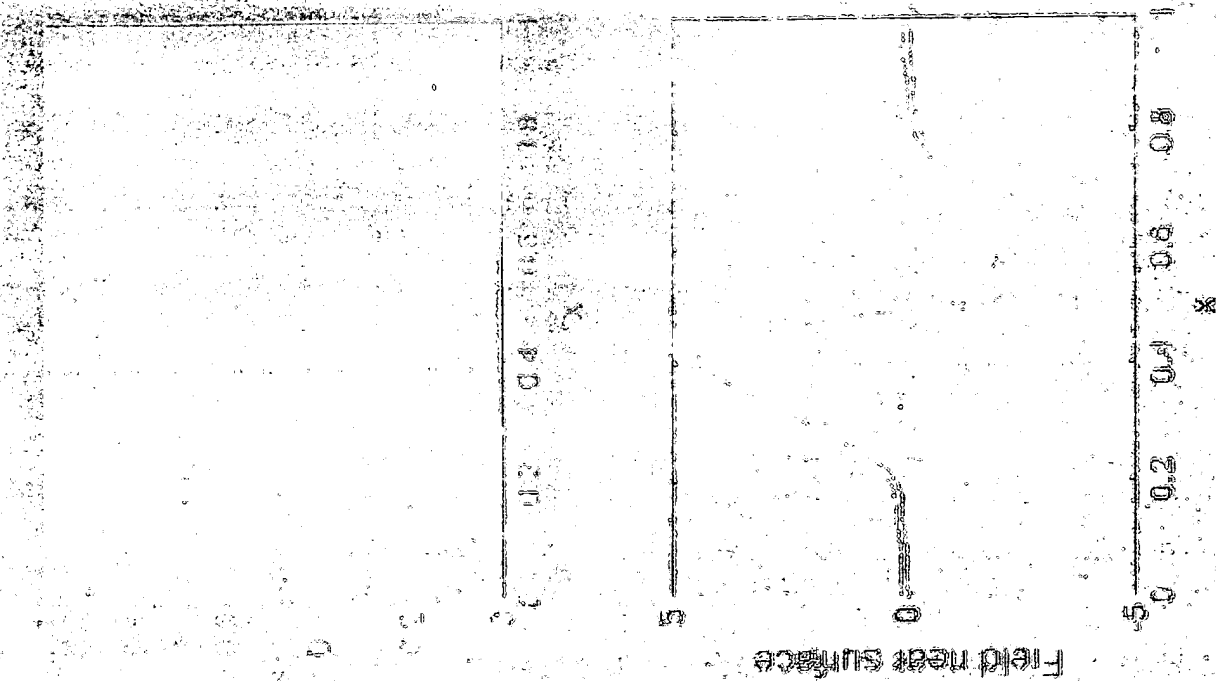
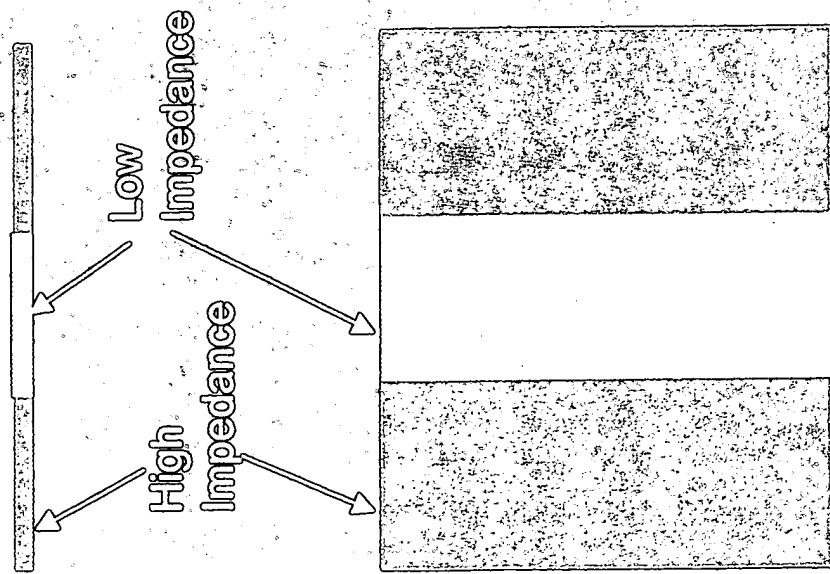
# LIGHT-GUIDED YEAST CELL ARRAYS



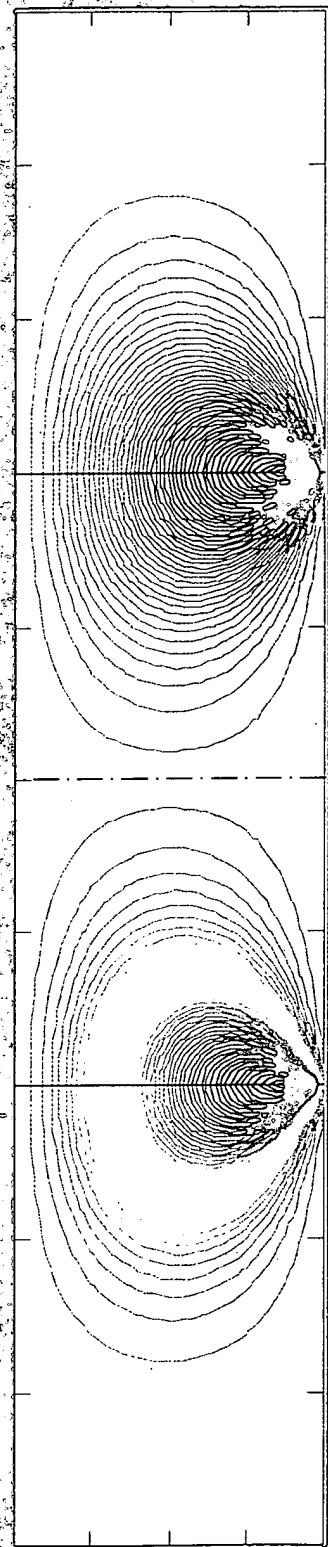
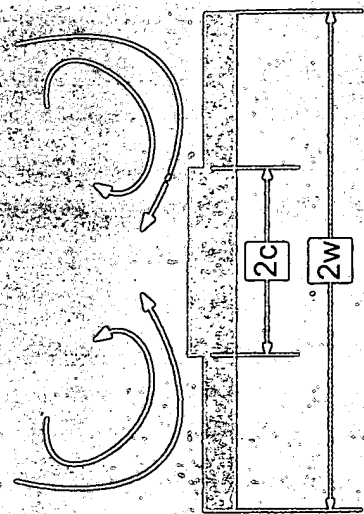
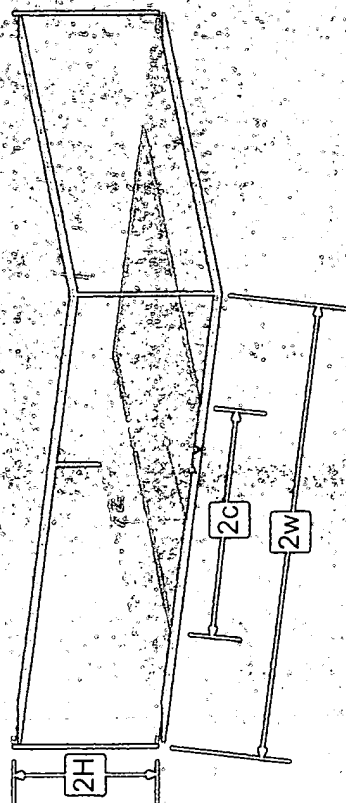
# Conclusions

- Optically programmable array assembly and reconfiguration
- Customized microparticle arrays
  - DNA chip
  - Protein chip
- Advanced on-chip Cellular Analysis

# Electric Field Near Surface

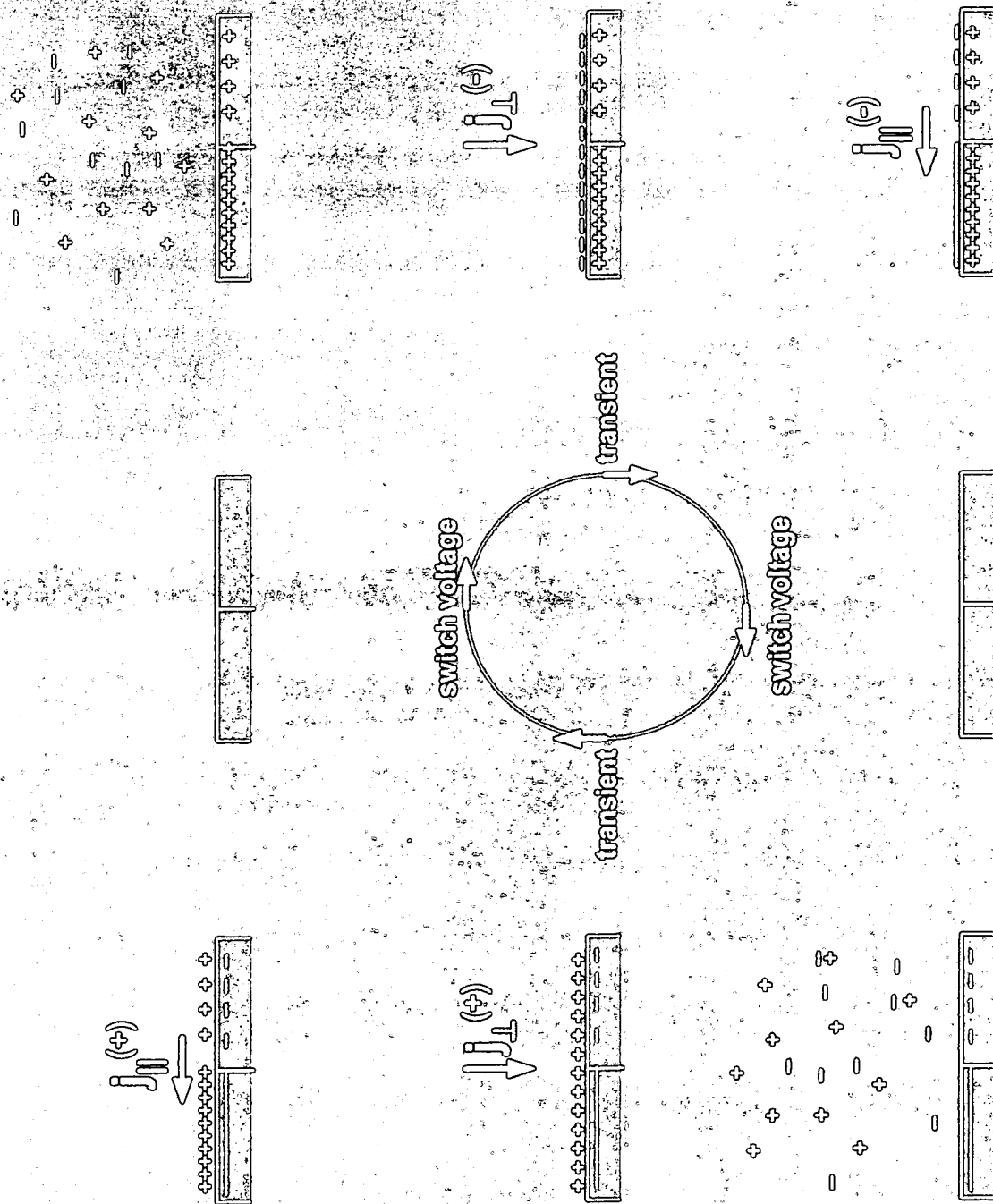


# Simulation of Fluid Flow in Slot Geometry

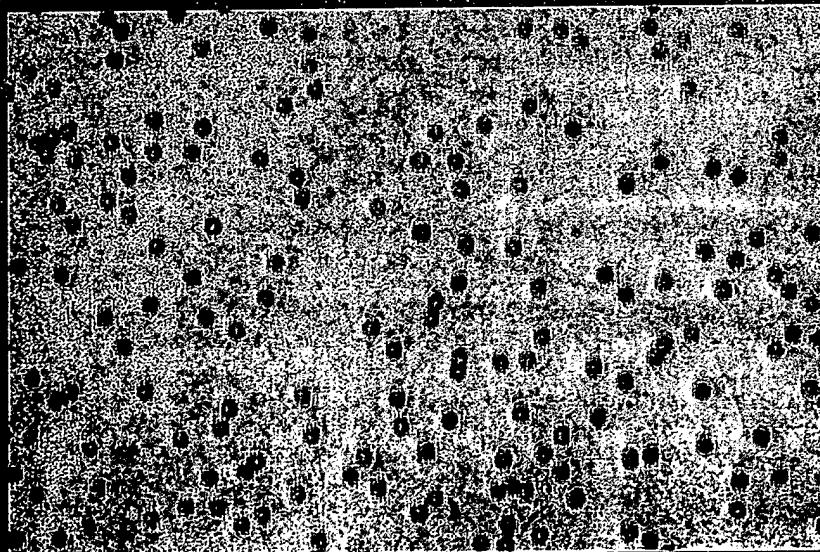
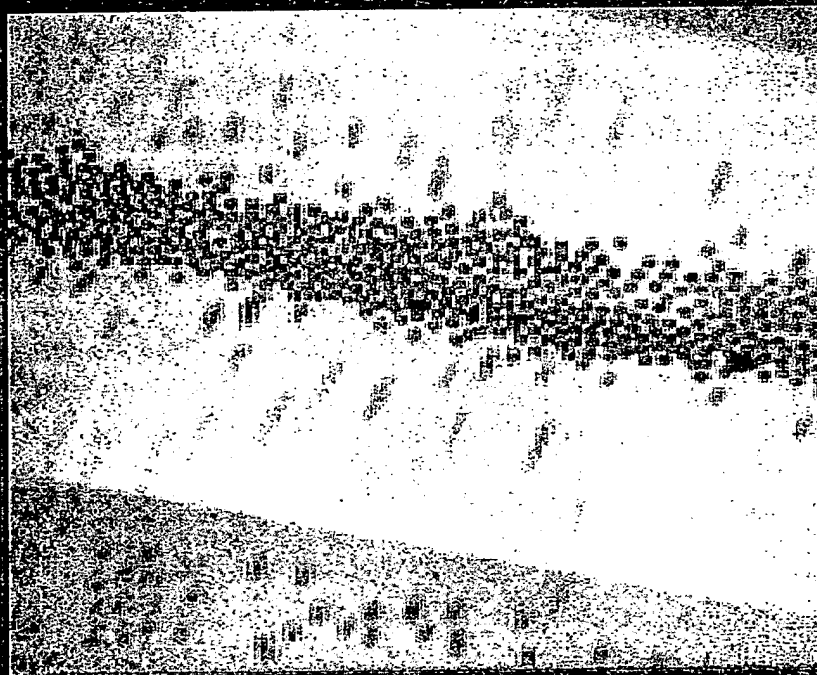
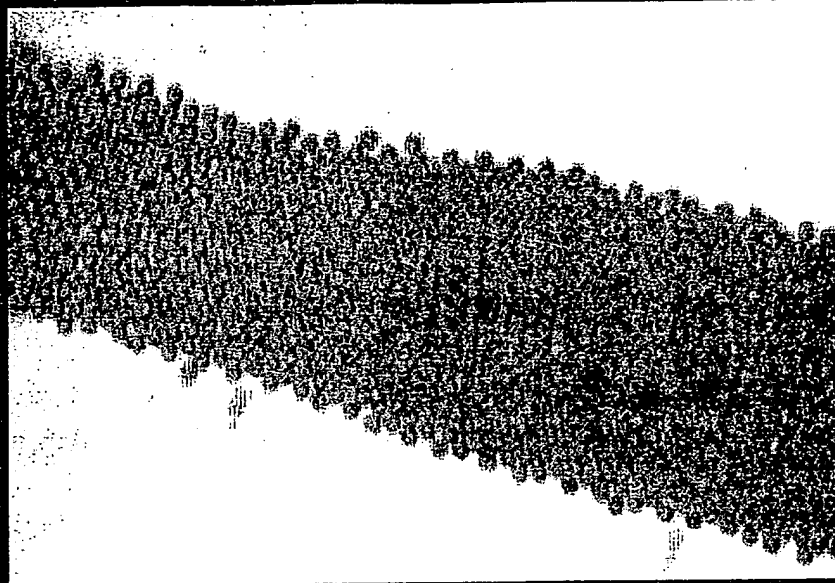




# Flow Rectification



# Array Assembly

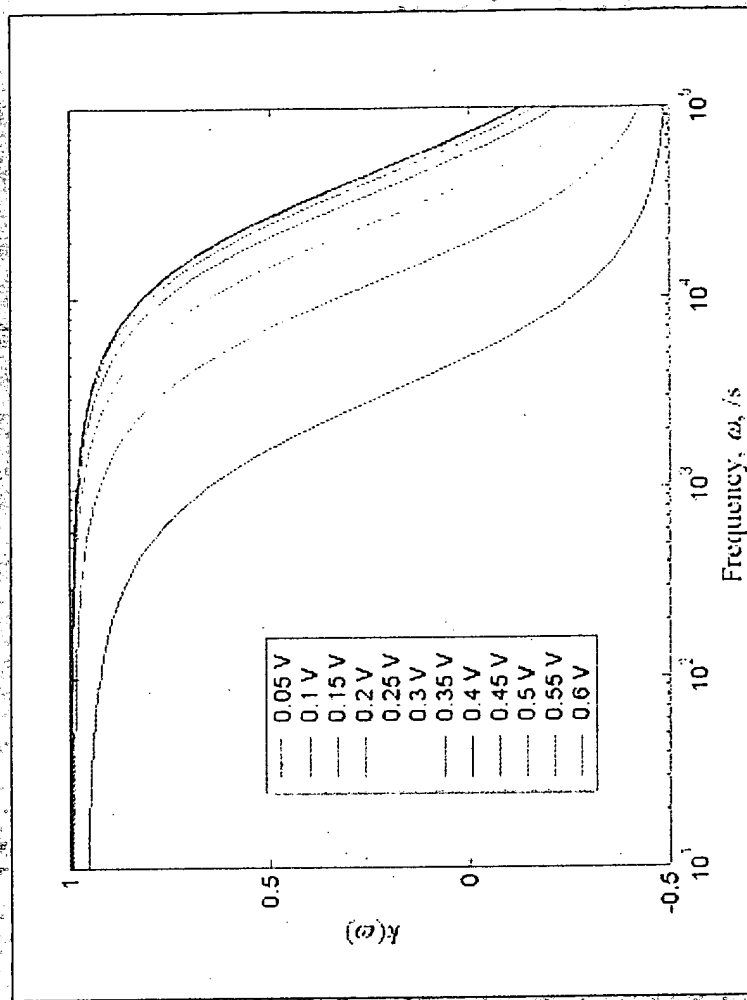
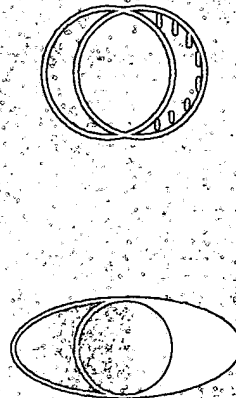


# Bead Polarization

$\omega = 0$     $\omega = \pi/2$     $\omega = \pi$     $\omega = 3\pi/2$     $\omega = 2\pi$



$$E_{\text{ext}} = E_0 \sin(\omega t)$$



$$\omega_R \approx \frac{D\kappa^2}{(1+a\kappa)^2} = \frac{\kappa^2}{(1+a\kappa)^2} \frac{(k_B T / e) \mu}{(1+a\kappa)^2}$$

$$K(\omega) = (\epsilon_s(\omega) - \epsilon_m) / (\epsilon_s(\omega) + 2\epsilon_m)$$